Quarterly Progress Report 2

For the project entitled:

**A HIGH FIDELITY DRIVING SIMULATOR AS A TOOL FOR DESIGN
AND EVALUATION OF HIGHWAY INFRASTRUCTURE UPGRADES**

Reporting Period: July 1 – September 30, 2006
(First Quarter of State Fiscal Year 2007)

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**Task A. Project Management**

The initial task was management and coordination of the project including financial management, technical tracking and reporting. In conjunction with MDT staff, we determined to develop simulation of US 191 through Gallatin Canyon representing milepost 48 through milepost 70. At the suggestion of the MDT Director, it was decided to evaluate the impact of variable speed limits, as posted on virtual DMS signs, on the speed and behavior of drivers. It was decided that a demonstration of the simulation would be presented at the National Rural ITS conference in Big Sky during August, 2006. This demonstration was presented as planned.

Task B. Develop Tiles and Scenarios Specific to U.S. 191

The manufacturer of the simulation system, DriveSafety, Inc., developed a series of six custom tiles representing the highway and terrain of US 191 through Gallatin Canyon between milepost 48 and milepost 70. To develop this simulation, DVD footage of the roadway was recorded and sent to the simulator manufacturer. In addition, the engineering road drawings for typical horizontal curve profiles, and GPS data for each mile marker (north and southbound) along the segment of roadway of interest were supplied. The manufacturer's tile designer also employed the USGS mapping information. The GPS data was not used as the measured latitude/longitude data did not register accurately with the latitude/longitude coordinates in the USGS mapping system. The designer used MultiGen Creator Pro and Adobe Photoshop software to generate the visual database. Additional proprietary software was employed by the manufacturer to generate the additional datasets required for the real-time system. The visualization included the two-lane highway bordered by mountains and a river. Both sides of the right-of-way were forested and guard rails were placed along the road as it curved next to the river. The two bridges over the river were protected by concrete barriers. The visual simulation prepared by DriveSafety did not include cultural features such as buildings and fences. These were added in the appropriate locations using the HyperDrive data base of simulation entities with the DVD footage used as a guide. A custom guardrail entity was made available to allow placement of additional guardrails by click-and-drag operation which proved to be a cumbersome and time In some areas, trees were also added to the tiles to more closely resemble the heavily forested roadsides. One necessary departure from the real world roadway was that the rural buildings and fences on the generic simulation entities menu are of typical design for a rural Midwestern landscape. In the real-world environment of US 191, a much greater use of rustic materials such as logs and rock are used in building.

Entering 35 MPH Bridge (Actual)
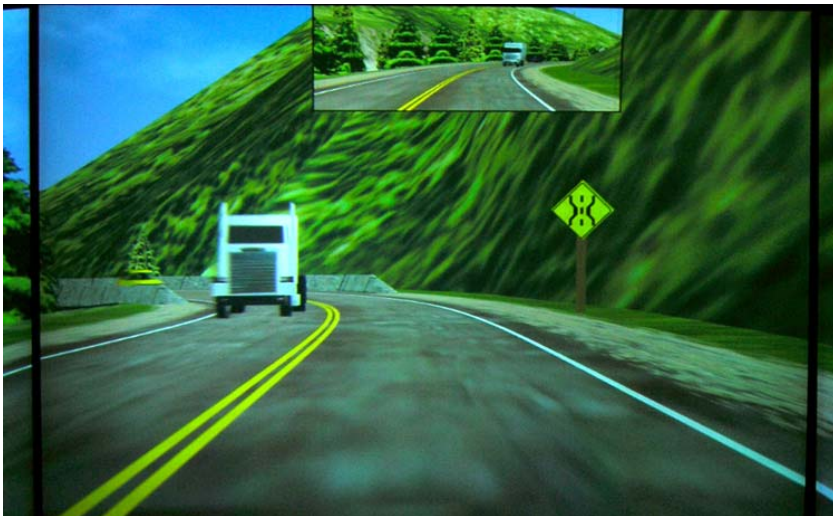
Entering 35 MPH Bridge (Visualization)

Entering 35 MPH Bridge in foggy weather (Visualization)

A demonstration of the visualization system was prepared for presentation at the National Rural ITS conference hosted by WTI at Big Sky in August, 2006. The study methodology was a featured article in the WTI Newsletter distributed at NRITS. Videos of the simulated drive through the Gallatin Canyon area, recorded from the driver's point of view, were shown at the WTI booth in the exhibit area. Interested attendees were invited to visit WTI and drive the actual simulation on their return to/through Bozeman and several took advantage of this opportunity.

WTI encourages MDT staff to visit the WTI simulation laboratory to drive the simulated highway to explore potential additional uses.

Task C. Evaluate Driver Performance and Behavior

During Task C, scenarios were developed using the custom tiles to simulate potential ITS deployments and to obtain data on a sample of drivers who drive on the simulated roadway. For an initial test, scenarios using "variable" speed limits posted on virtual DMS signs.   A sample of drivers representing a mix of genders and ages is being recruited to represent the typical driving population of U.S. 191.

Speeds were tested with no posted speed limits, speeds posted at a 60 MPH limit on a DMS on a gantry over the road, and speeds posted at 50 MPH on a DMS gantry over the road. Speeds were measured at each milepost. The roadway geometry at the measurement point was categorized as straight, curving, entering a curve, or exiting a curve. The preliminary results presented here are based on six trials at each of the three speed limit conditions.

Because of differences in measurement methods between the simulator and the real-world driving environment, it is not possible to directly compare the simulation with the real world. Speeds measured in the simulator with no posted speed limits and with 60 MPH limits posted on DMS signs were very close to those reported and experienced on the actual roadway. There was little difference between the speed profiles (mean and 85th percentile speeds) between the posted 60 MPH limit and with no posted limit. With the posted 50 MPH limit, speeds remained the same in the curves but were approximately 6 MPH slower in the straight sections than with more permissive limits.
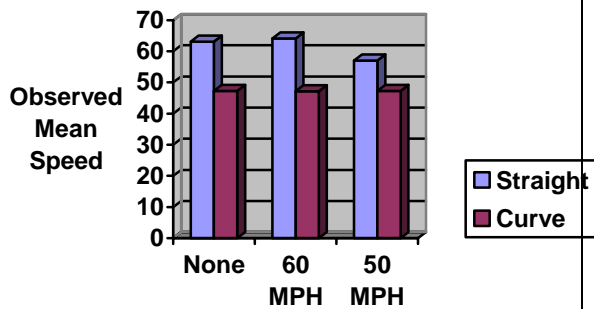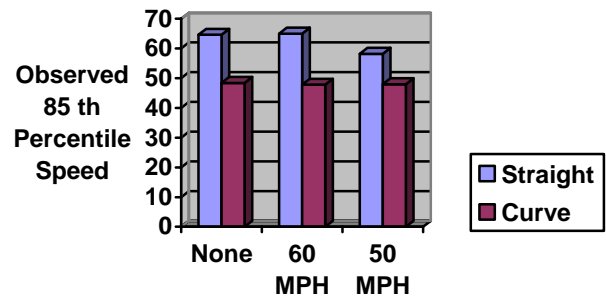
Figure 8. Effect of Posted Speed Limit

Figure 9. Effect of Posted Speed Limit

Task D. Validate Driver Performance Data

Task D compares driver performance data collected in the simulator with available data from the selected roadway to ensure that driver performance represents that shown in the real world. Typically, speeds driven in a driving simulator are found to be greater than those driven on the roadway being simulated. A small sample of pilot data shows that speeds registered in the simulator are realistic and typical of speeds normally driven on that section of roadway.

A measurement system was developed in which speeds were measured at each milepost and the roadway geometry was characterized as straight, curving, entering a curve, or departing a curve. Speeds were measured in the simulator in a series of pilot studies with varying amounts of ambient traffic including: (1) light ambient traffic, moderate ambient traffic with little speed variance, and (3) traffic with significant speed variance due to slow-moving (45 MPH) trucks. Simulator mean speeds varied between 45 and 65 mph depending on geometry and traffic. The 85th percentile speeds were approximately 2 MPH faster. Speeds in straight sections were typically 10 MPH – 12 MPH faster than in curving sections. It should be noted that the simulator vehicle did not have a cruise control capability so the drivers had active control of their speeds.

Budget Category	Budgeted Funds	Spent this Period	Total Spent	Total Remaining
Salaries	15,232.00	5,344.94	9,998.34	5,233.66
Benefits	4,570.00	1,228.13	2,598.99	1,971.01
Travel		341.25	416.90	-416.90
Communication	100.00	0.00	62.61	37.39
Contracted Services	1,250.00			1,250.00
Supplies	100.00			100.00
Participant Support	700.00			700.00
MDT Direct Costs	21,952.00	6,914.32	13,076.84	8,875.16
Overhead	4,250.00	1,382.90	2,615.35	1,634.65
MDT Share	**26,202.00**	**8,297.22**	**15,692.19**	**10,509.81**
WTI/MSU Share	22,500.00	11,250.00	22,500.00	0.00
Total	**48,702.00**	**19,547.22**	**38,192.19**	**10,509.81**

Project Schedule Summary

An updated summary of the project schedule is shown in figure following. The project is scheduled to be completed in the next quarter. The project is slightly behind schedule with data collection being completed and report preparation in progress. WTI will request a short no-cost extension to complete the effort.

Tasks Percentage Complete